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Space Law Treaties and Principles: Contemporary Gaps, Challenges, and Reform Needs in the New Space Age

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Abstract

Space law was developed at a time when space activities were limited to a few powerful nations and were mainly scientific or military in nature. However, the present era, known as the New Space Age, is marked by rapid commercialization, private space companies, satellite mega-constellations, space tourism, and growing military use of outer space. This paper examines the major international space law treaties and principles and highlights the serious gaps and challenges they face today. It argues that existing laws are outdated, weak in enforcement, and unclear about private actors' responsibilities. The paper also discusses the urgent need for legal reforms to ensure peaceful, sustainable, and fair use of outer space in the future.

Keywords: Space Law, Outer Space Treaty, New Space Age, Commercial Space, Space Governance

1. Introduction

Space law is the set of rules that govern human activities outside of Earth, such as launching satellites, using space technology, rescuing astronauts, fixing liability if damage occurs, and sharing information about space risks. The UN Committee on the Peaceful Uses of Outer Space (COPUOS), which was set up by the UN General Assembly in 1959 to promote peaceful and cooperative use of outer space, is the main organisation that builds it. [1] The five UN space treaties are the main parts of international space law, and the Outer Space Treaty (OST) is the most important one. [2] The OST was adopted in 1966, opened for signature in 1967, and went into effect on October 10, 1967. It sets out important rules, such as that space should be used peacefully, that everyone should be free to explore it, and that no country can claim it as its own. [3] But by 2022, space activities had grown quickly and become more commercial and crowded. This made new legal and governance problems that older treaties didn't clearly cover. Space debris is a big problem. The European Space Agency said in 2022 that it was keeping an eye on more than 30,000 debris objects, and its models showed that the real number of objects larger than 1 cm is probably over one million. This makes collisions more likely and makes space operations less safe and sustainable. [4]

Space is no longer just for scientific research or missions run by the government. In the current New Space Age, space activities have grown quickly to include private satellite launches, commercial communication networks, space tourism, military surveillance, and plans for mining resources on asteroids and the moon in the future. Private companies like SpaceX, Blue Origin, and OneWeb have changed the game by lowering launch costs, making space more accessible, and bringing market-driven models of space exploration to the table. As a result, outer space has changed from a strategic and scientific area to a very competitive business and political space where both state and non-state actors are involved. International space law, on the other hand, was mostly made during the Cold War, when only a few countries were doing space activities and they were mostly for scientific research and national security. The main treaties, especially the 1967 Outer Space Treaty[5], were made to stop the militarisation of space, keep countries from claiming celestial bodies as their own, and encourage peaceful use and cooperation between countries. These principles worked well to keep things stable in the early years of space exploration, but they were made for a very different political and technological situation.

In the modern world, current space law has a lot of problems dealing with things like the dominance of the private sector, the buildup of space debris, the commercialisation of space resources, cybersecurity threats, and the growing militarisation of space through technologies that can be used for both military and civilian purposes. The current legal framework does not have clear rules about holding private actors responsible, enforcing those rules, protecting the environment in space, or giving developing countries equal access. These gaps have caused

confusion and legal ambiguity, which has made people worry about safety, sustainability, and fairness in future space activities.

In this context, the current paper seeks to critically analyse existing space law treaties and principles, pinpoint their deficiencies in the framework of the New Space Age, and underscore the pressing necessity for legal and institutional reforms. The study aims to enhance the current dialogue on the modernisation of international space law to guarantee peaceful, sustainable, and inclusive governance of outer space in the twenty-first century by examining contemporary challenges in conjunction with emerging space activities.

2. Literature Review

Ramakrishna S. Jakhu's book International Space Law: A Treatise, published by Springer in 2010[6], is one of the most thorough and reliable studies of international space law. His research concentrated on the Outer Space Treaty of 1967 and other United Nations space law instruments, elucidating how these treaties effectively averted national sovereignty assertions and extensive military conflict during the Cold War era. Jakhu found that these treaties did a good job of making outer space a global commons, but they don't have strong enforcement mechanisms and don't give much guidance on how to do business or live in space today. He used Global Commons Theory to say that shared areas like outer space need stronger rules for everyone to follow to stop misuse, inequality, and problems with long-term sustainability.

In the Indian Journal of International Law**,** S. R. Rao (2012)[7]ooked at India's legal status in the context of international space law and pointed out that India does not have a complete national space law. His research indicated that India predominantly depends on policy documents and executive directives rather than enforceable legislation to govern space activities. Rao determined that policy-based regulation is insufficient in the New Space Age, especially given the rising involvement of the private sector and international cooperation. Using Institutional Governance Theory, he stressed that India needs laws to make sure that the growing space sector is accountable, open, and legally certain.

In their 2013 article in the Journal of Space Law, Jakhu and Pelton[8] looked at the quickly growing problem of space debris and what it means for the law. They contended that current international space treaties fail to impose obligatory responsibilities on states for debris mitigation or removal, instead depending on voluntary guidelines. The authors determined that the absence of enforceable environmental standards constitutes a significant risk to the enduring viability of space endeavours. Using Environmental Governance Theory, they said that outer space should be seen as a fragile ecosystem that needs international laws that are just as strong as those that protect the environment on Earth.

In Strategic Analysis (2014)[9], B. Gopalaswamy looked into the militarisation of outer space, focussing on how satellites are being used more and more for surveillance, communication, and defence. He said that international space law does not do a good job of regulating conventional or dual-use military technologies, even though it does ban weapons of mass destruction in space. Gopalaswamy said that space law hasn't kept up with the way things are now in terms of strategy. He used Realist Security Theory to say that states put their own security interests ahead of their idealistic legal commitments to peaceful use.

Jakhu (2015)[10], in a chapter from Space Safety Regulations and Standards published by Elsevier, talked about liability problems under the 1972 Liability Convention. He emphasised that international liability is predominantly state-centric, even in instances of harm inflicted by private commercial entities. Jakhu came to the conclusion that this method makes the law unclear and makes people less likely to invest in space activities. He suggested shared liability frameworks that mix state oversight with direct private accountability to better reflect how space operations work today through Legal Responsibility Theory.

T. N. Srinivasan (2016)[11], in the Economic and Political Weekly, examined the commercialisation of outer space, focussing on the growth of private satellite services and launch markets. He determined that ambiguous legal regulations concerning ownership rights, licensing processes, and dispute resolution frameworks hinder economic development and

innovation within the space industry. Srinivasan contended that, from the standpoint of Economic Liberalisation Theory, legal certainty and predictable regulatory frameworks are essential for attracting private investment while ensuring international cooperation and compliance.

S. Chakrabarti (2017)[12], in an issue brief released by the Observer Research Foundation, analysed India's involvement in global space governance and its engagement in UNCOPUOS. His research underscored that developing nations encounter inequitable access to space attributable to technological, financial, and institutional impediments. Chakrabarti found that current international space law frameworks tend to favour countries that are already good at space travel. Using Post-Colonial Theory, he said that changes to space law need to fix structural inequalities and encourage inclusive governance to stop powerful states from taking over.

Jakhu and Freeland (2018)[13], in their book The Global Space Governance System published by Springer, looked at the legal problems that come up when people want to use space resources, like mining asteroids and getting resources from the moon. They determined that national legislation allowing private resource exploitation is at odds with the non-appropriation principle of the Outer Space Treaty. The authors contended, based on the Common Heritage of Mankind Theory, that space resources ought to be regulated by multilateral agreements to guarantee fair distribution of benefits and avert unilateral exploitation.

P. S. Rao (2019)[14], in the Asian Journal of International Law, analysed dispute resolution mechanisms within international space law, identifying them as weak, fragmented, and predominantly voluntary. He came to the conclusion that the lack of a specific international body for resolving space disputes makes it harder for people to follow the law and be sure of their rights. Rao suggested the creation of arbitration mechanisms and a UN-supported space authority to improve dispute resolution and enforcement through International Legal Process Theory.

Jakhu, Chatterjee, and Singh (2021)[15] examined emerging challenges, including satellite mega-constellations, cybersecurity threats, and the application of artificial intelligence in space systems, in their article published in Space Policy by Elsevier. They determined that current space law treaties are technologically obsolete and inadequate for governing autonomous and data-driven space operations. The authors used Adaptive Governance Theory to stress the need for legal systems that are flexible and ready for the future and can change with technology.

3. Major Space Law Treaties

Five accords that the United Nations passed between 1967 and 1979 make up much of international space law. These treaties were made in the early days of space exploration, when most of the work was done by governments and was motivated by Cold War security concerns. Their main goal was to stop wars from happening in space and to encourage countries to work together. These instruments set important legal standards, but they don't have anything to do with modern business and technology in space.

Outer Space Treaty (1967)

The Outer Space Treaty (OST) is the main regulation that governs space travel across the world. It says that outer space should only be used for peaceful purposes and that no country can claim control over it or celestial bodies. The treaty also says that weapons of mass destruction can't be put in orbit or on other planets.

The notion of state responsibility is a key part of the OST. It says that all national space activities, even those done by private companies, are the responsibility of the state. This idea is still very important now because private space enterprises are growing so quickly. The treaty, on the other hand, doesn't do a good job of covering modern business operations, the use of space resources, or the use of advanced military and dual-use technologies. This leaves big holes in the rules.

Rescue Agreement (1968)

The Rescue Agreement expands the humanitarian principles of the Outer Space Treaty by

requiring states to assist astronauts in distress and ensure their safe return. It also obligates states to return space objects that land unintentionally on their territory. This agreement reflects the early perception of astronauts as representatives of all humanity and promotes international cooperation. However, its scope is limited in the contemporary context, as it does not clearly address private astronauts, space tourists, or commercial human spaceflight, which are increasingly common in modern space operations.

Liability Convention (1972)

The Liability Convention sets up a legal system for paying for damage caused by space objects. It makes people completely responsible for damage that happens on Earth and only partially responsible for damage that happens in space. This convention is one of the few things that can be enforced in international space law. Even though it is important, the convention is still mostly focused on states and does not clearly say who is responsible for what between states and commercial space operators. This lack of clarity makes it harder to resolve disputes and hold people accountable, especially because private companies are playing a bigger role in satellite launches and space missions.

Registration Convention (1975)

The goal of the Registration Convention is to make things more clear by making countries register things that are sent into space and give the UN basic information about them. This helps figure out who is to blame for damage or problems with space objects. The convention helps states create trust in each other, but it doesn't deal with modern problems like real-time satellite tracking, managing space debris, or controlling big groups of satellites. As space gets busier, the treaty's minimal reporting obligations make it less useful in practice.

Moon Agreement (1979)

The Moon Agreement says that the Moon and other celestial bodies are the common inheritance of all people, and it tries to control what people do there. It encourages fair sharing of the advantages that come from space resources and stresses the need to use space peacefully and safeguard the environment. But only a few states have accepted the agreement, and none of the main spacefaring nations are part of it. Because of this, it has very little legal power over existing and future space activities, such as mining on the moon and using its resources.

4. Contemporary Gaps in Space Law

Despite the existence of foundational space treaties, international space law has not evolved at the same pace as technological, commercial, and strategic developments. Reports by international organisations and academic surveys consistently highlight significant legal gaps that threaten the long-term sustainability, security, and equity of outer space activities.

4.1 Commercialization and Private Actors

International space treaties were drafted during a period when space activities were almost entirely controlled by governments. However, the space sector has undergone a dramatic transformation. According to the OECD Space Economy Report, the global space economy crossed USD 500 billion, with private companies accounting for more than 70% of satellite launches by the late 2010s [16]. Private actors such as SpaceX, Blue Origin, and OneWeb now dominate satellite deployment, launch services, and space tourism. Yet, international space law does not clearly define the rights, obligations, or liabilities of private entities. Instead, responsibility is indirectly placed on states under Article VI of the Outer Space Treaty. Surveys conducted by space law scholars indicate that this indirect approach creates regulatory uncertainty, discourages accountability, and complicates cross-border dispute resolution [17]. As a result, national laws vary widely, leading to fragmented governance and legal inconsistency in commercial space operations.

4.2 Space Debris and Environmental Protection

Space debris has emerged as one of the most serious threats to safe space operations. According to the European Space Agency (ESA), there are more than 34,000 tracked debris objects larger than 10 cm and millions of smaller fragments orbiting the Earth [18]. Even tiny debris can destroy active satellites due to extremely high orbital speeds.

Current space treaties do not impose binding obligations for debris mitigation or removal. Existing guidelines, such as those issued by UNCOPUOS and the Inter-Agency Space Debris Coordination Committee (IADC), are voluntary in nature [19]. Studies warn that continued inaction may trigger the Kessler Syndrome, a chain reaction of collisions that could make certain orbits unusable for decades. The absence of enforceable environmental protection rules reflects a major gap in treating outer space as a shared and fragile environment.

4.3 Militarization of Outer Space

While the Outer Space Treaty prohibits weapons of mass destruction in space, it does not effectively regulate conventional weapons, dual-use military satellites, or cyber operations targeting space infrastructure. According to a UN Institute for Disarmament Research (UNIDIR) report, over 90% of modern military operations depend on satellite systems for communication, navigation, and surveillance [20]. Recent tests of anti-satellite (ASAT) weapons by major powers have generated large debris clouds, raising global security concerns. For example, a single ASAT test conducted in the early 2020s produced over 1,500 trackable debris fragments [21]. Strategic studies show that space law has failed to keep pace with evolving military technologies, allowing states to prioritise national security interests over collective space security. This legal gap increases the risk of conflict escalation and accidental interference in outer space.

4.4 Resource Exploitation

The issue of space resource extraction represents one of the most contested gaps in international space law. While the Outer Space Treaty prohibits national appropriation, it remains silent on commercial extraction of resources. In response, countries such as the United States and Luxembourg have enacted national laws permitting private asteroid mining. Legal scholars argue that such unilateral legislation challenges the principle of space as the "common heritage of mankind", particularly emphasized in the Moon Agreement. Surveys of developing nations reveal concerns that technologically advanced states may monopolize space resources, deepening global inequalities. The absence of a universally accepted international framework for space mining creates legal uncertainty, competition, and potential conflict over ownership and benefit-sharing.

4.5 Weak Enforcement Mechanisms

One of the most critical weaknesses of international space law is the lack of enforcement mechanisms. Space treaties do not establish penalties for violations, compulsory compliance measures, or a dedicated international space court. Dispute resolution largely depends on diplomatic negotiations, which are slow and rarely used. According to a review by the Asian Journal of International Law, no formal liability claim under the Liability Convention has been fully adjudicated through a binding legal process [22]. This highlights the voluntary nature of compliance and the absence of legal certainty. Experts widely agree that without enforceable rules, international space law relies more on political goodwill than legal obligation, reducing its effectiveness in addressing modern challenges.

5. Challenges in the New Space Age

The New Space Age is a time of exceptional expansion in space operations, thanks to fast technological progress and considerable participation from the commercial sector. Technologies like reusable launch vehicles, tiny satellites, AI-powered systems, and commercial human spaceflight have made it much cheaper to launch things and made space more accessible. For example, the cost of sending a kilogramme into low Earth orbit has reduced a lot in the last 20 years, making it possible to launch more often and have shorter mission cycles. But international space law has not kept up with the pace of change, leaving gaps in the rules about safety requirements, accountability, and liability for new technologies.

One of the biggest problems that has come up because of these changes is that space is getting more crowded, especially in low Earth orbit. Right now, there are thousands of satellites in orbit, and there are plans for many more as part of big satellite mega-constellation projects to provide internet and communication services over the world. This congestion makes it more

likely that satellites may crash into each other or that radio waves will get in the way. Even one collision can create thousands of pieces of debris that could stay in orbit for years and pose a threat to other spacecraft. Because there are no enforceable international regulations for managing space traffic, it is becoming harder and harder to use crowded orbits in a way that is both coordinated and long-lasting.

The New Space Age has also made it harder for underdeveloped countries to get into space than for developed countries. Advanced spacefaring nations have the money, technology, and rules they need to take advantage of commercial space activities. On the other hand, many developing countries depend more on space services than on taking part in space missions. This disparity makes people worry that outer space may progressively benefit technologically advanced countries, which goes against the idea that space operations should benefit all of humanity.

Another big problem is that there is no global space governance authority that can make and enforce rules. International organisations can help with coordination, give advice, and set up places for people to talk, but they can't force people to follow the rules or punish them. Because of this, following space rules generally rely on people working together and politicians being willing to do so. This institutional limitation makes it harder for countries to work together to solve problems like space debris reduction, military activity in space, and commercial regulation.

Finally, problems between national space laws and international standards are becoming more and more difficult to deal with legally and politically. To control private space operations and encourage business interests, such as using space resources, several countries have passed laws in their own countries. These kinds of legislation make things clearer at the national level, but they can also cause problems with international rules like non-appropriation and peaceful usage of outer space. The lack of agreement between national legal systems and international norms makes it more likely that there will be legal confusion, competing regulations, and future conflicts between spacefaring actors.

6. Need for Legal Reforms

The rapid changes in space operations throughout the New Space Age have made it clear that current international laws are not enough. The increasing power of private actors, the growing congestion in orbital habitats, worries about militarisation, and competition for space resources all call for quick and coordinated changes to the law. If international space law isn't updated on time, it could become less useful and relevant in making sure that space is used peacefully, fairly, and in a way that lasts.

The Outer Space Treaty (1967) is still the most important piece of international space legislation, but it shows how things were back then, when states were the most important and technology was still new. As it stands now, the treaty only lays forth general concepts and doesn't have any specific rules about private company responsibility, environmental protection, or commercial space activity. Since private corporations currently do a lot of launches and satellite operations, the law needs to be explicit about their rights, duties, and responsibilities. Adding more protocols to the treaty or changing it could make it clearer for businesses what their licensing requirements, safety standards, and compliance processes are. In addition, including clear rules for protecting the environment will help ease worries about the long-term usage of space and orbital sustainability. Updating the Outer Space Treaty would not weaken its core values; instead, it would make it more relevant in today's space industry. Space debris is one of the biggest dangers to the safety and long-term viability of activities in space. There are voluntary norms for reducing debris, but they are not legally binding and are not often followed. Because there are no enforceable international norms, states and commercial operators can put short-term economic or strategic goals ahead of long-term orbital safety. It is required to change the law so that there are rules that can be enforced around the world for debris reduction, post-mission disposal, and active debris cleanup. These regulations should have standards for mandatory compliance, requirements for clear reporting, and ways

for everyone to share responsibility. If we had strict rules about debris, the chances of collisions would go down a lot, and we would be able to keep important orbital areas safe for future generations.

International space law forbids weapons of mass destruction in space, but it doesn't do a good job of regulating regular military activities like anti-satellite (ASAT) missiles, military surveillance systems, and cyber operations that target space infrastructure. These actions make the situation less stable strategically and create a lot of debris that could damage both civilian and commercial space assets. Legal changes should set explicit restrictions on the testing and use of ASAT weapons and encourage states to be more open and work together to establish trust. Setting legally binding rules for military restraint in space will lower the chances of conflict getting worse and keep space a place for peaceful and cooperative activities.

Fair Access to Space Resources: Using space resources like minerals from the Moon and asteroids can be good for business, but it can also raise moral questions. Without a defined international framework, technologically capable countries have started making national laws that allow private companies to take resources. This trend could push underdeveloped countries to the side and go against the idea that outer space belongs to all of humanity. Legal changes are needed to make sure that everyone has equal access and fair ways to share benefits, especially for countries who don't have modern space technology. Multilateral agreements could set up procedures for managing shared resources, exchanging technologies, and making financial commitments to help everyone take part in space operations. These steps would assist stop the monopolisation of space resources and make the world more fair.

Creation of a Global Space Governance Body: One major problem with international space law is that there is no central global space governance authority that can make rules and enforce them. The institutions that are already in place mostly give advice and help with coordination, but compliance is mostly up to the individual. This mismatch in institutions makes international rules less effective and makes it harder to settle disputes. Setting up an international space body based in the UN might make global space governance a lot stronger. This kind of group may make sure that international rules are followed, help settle disputes, coordinate space traffic management, and encourage environmentally friendly methods. A central authority would make things more open, accountable, and cooperative, making sure that space stays a safe and accessible place for all countries.

7. Conclusion

This study shows that international space law has been a stable and cooperative basis for space activity during the Cold War, but it is becoming less and less effective at dealing with the reality of the New Space Age. The swift growth of commercial space activities, the predominance of private entities, the increasing amount of space trash, the development of new military technology, and the rivalry for space resources have revealed significant legal, institutional, and ethical deficiencies in the current framework. Foundational treaties like the Outer Space Treaty were made for a world where states were the main players and technology was limited. Because of this, they don't make it clear how to enforce them, hold individuals accountable, protect the environment, or make sure everyone has equal access. Contemporary scholarship and institutional reports indicate an imperative for legal reforms, encompassing the modernisation of fundamental treaties, the implementation of enforceable debris mitigation regulations, the clarification of military activity oversight, equitable resource-sharing frameworks for developing nations, and the creation of a formidable global space governance authority. It is important to deal with these problems by creating legal frameworks that are open to everyone, flexible, and easy to follow. This will help keep outer space peaceful, sustainable, and open to everyone in the twenty-first century.

8. Future Scopes of the Study

- Future study may concentrate on the development of adaptable and technology-responsive legal frameworks that can accommodate coming breakthroughs, such artificial intelligence-driven satellites, autonomous space systems, and space tourism.

- The research may be expanded to analyse the national space legislation of both established and developing spacefaring countries to evaluate their alignment with international space law principles and to determine optimal techniques for harmonisation.
- More study can look into ways for countries to work together to reduce space debris, safeguard the environment in orbit, and make sure that outer space stays a global commons for a long time.
- Future research may investigate equitable and inclusive legal frameworks for the use of space resources that guarantee participation and benefit-sharing for developing nations and nascent space entities.
- The study's scope may be broadened to evaluate the viability, framework, and legal jurisdiction of a specialised UN-centric global space governance entity for regulation, enforcement, and conflict resolution.

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